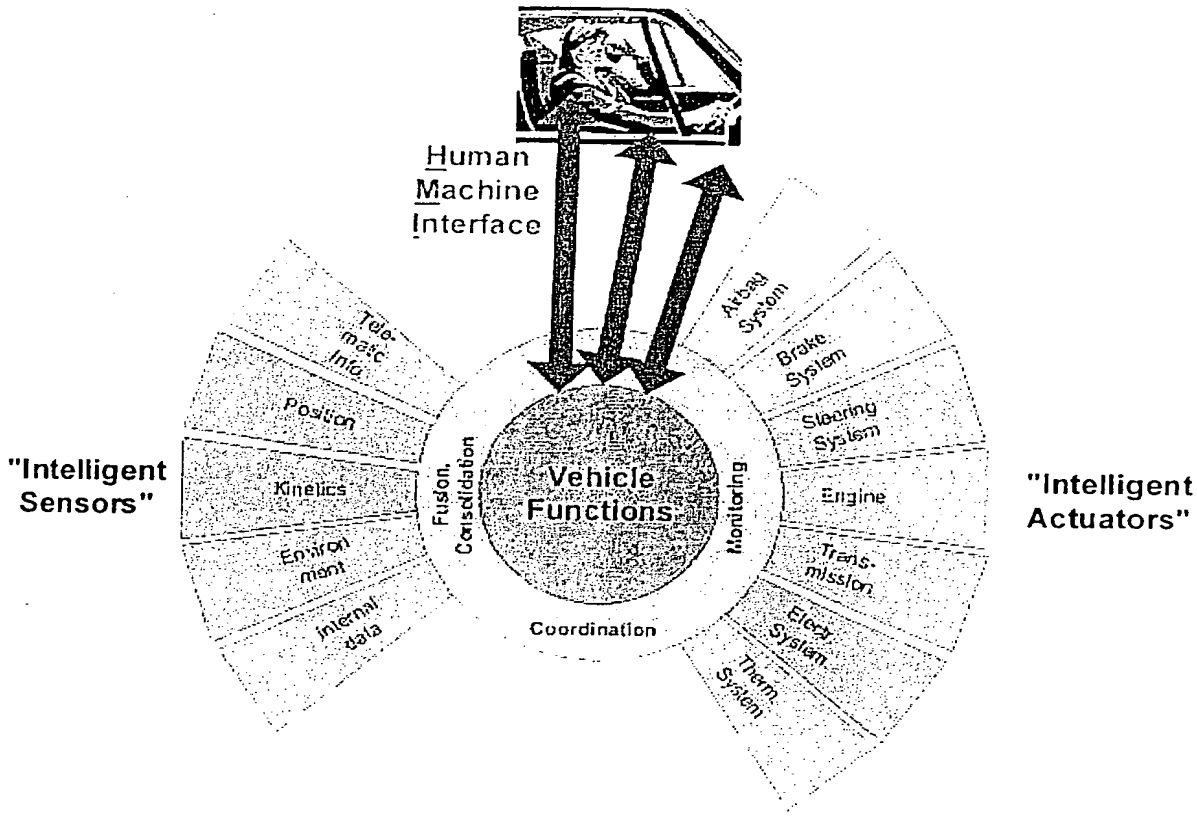

Fig. 1

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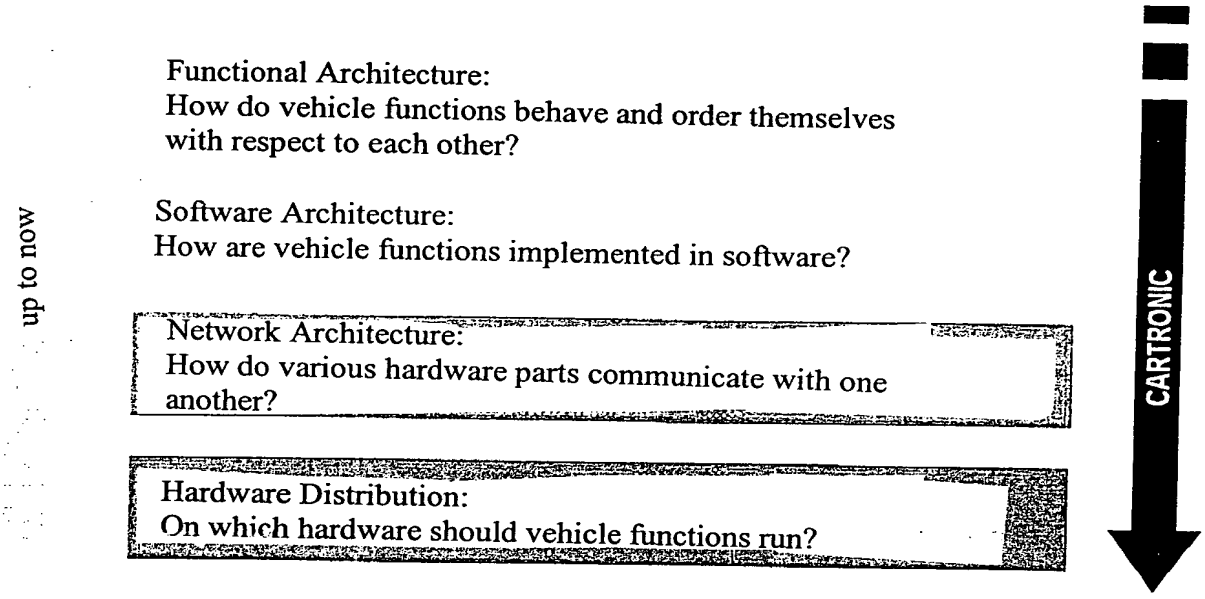

Functional Architecture:
How do vehicle functions behave and order themselves with respect to each other?
Software Architecture:
How are vehicle functions implemented in software?
Network Architecture:
How do various hardware parts communicate with one another?
Hardware Distribution:
On which hardware should vehicle functions run?
up to now
CARTRONIC

Fig. 2

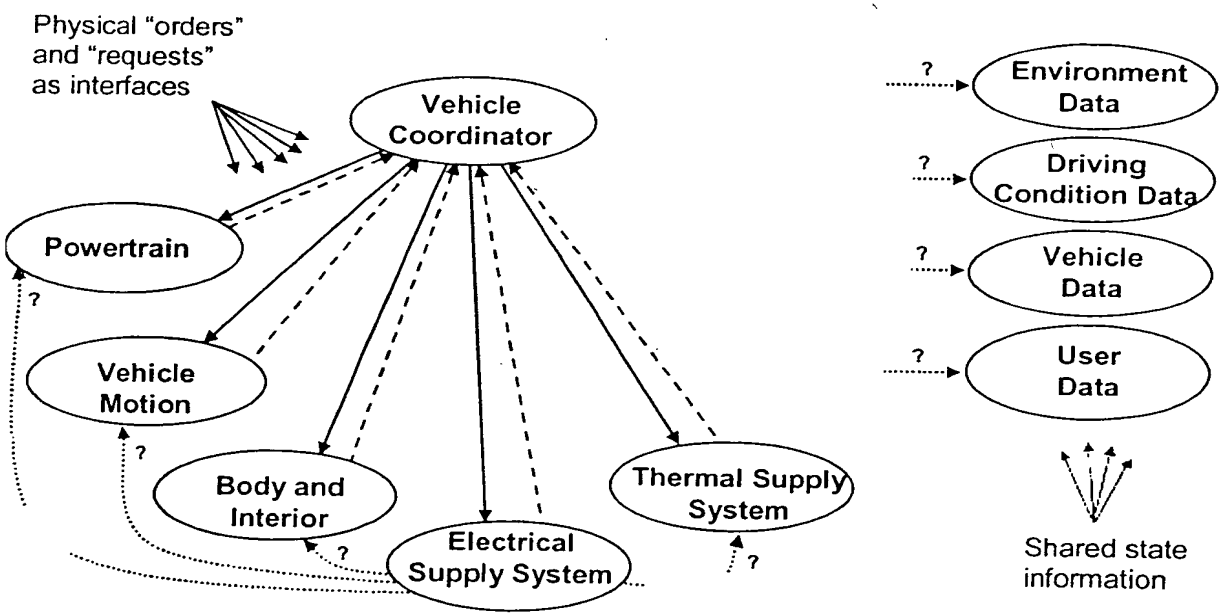

Physical "orders" and "requests" as interfaces
Vehicle Coordinator
Powertrain
Vehicle Motion
Body and Interior
Electrical Supply System
Thermal Supply System
Environment Data
Driving Condition Data
Vehicle Data
User Data
Shared state information

Fig. 3

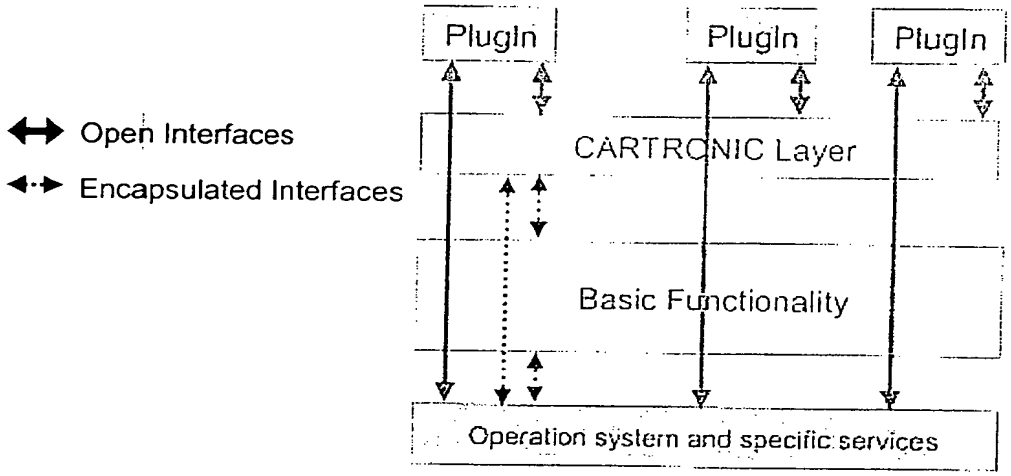
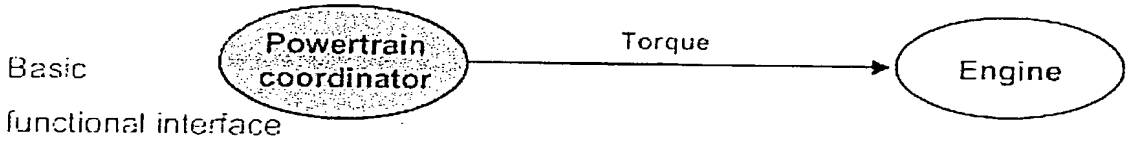
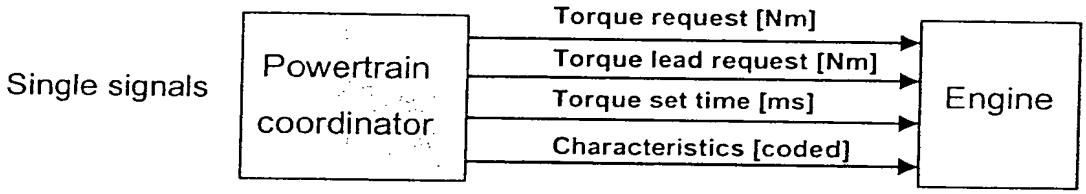


Fig. 4





Functional specification

Name	unit	data type	brief description
PTC_trqOrd	Nm	Real	This is the description of a single signal! This is the description of a single signal! This is the description of a single signal!
PTC_trqLeadOrd	Nm	Real	This is the description of a single signal! This is the description of a single signal! This is the description of a single signal!
PTC_tMax	ms	Real	This is the description of a single signal! This is the description of a single signal! This is the description of a single signal!

Fig. 5

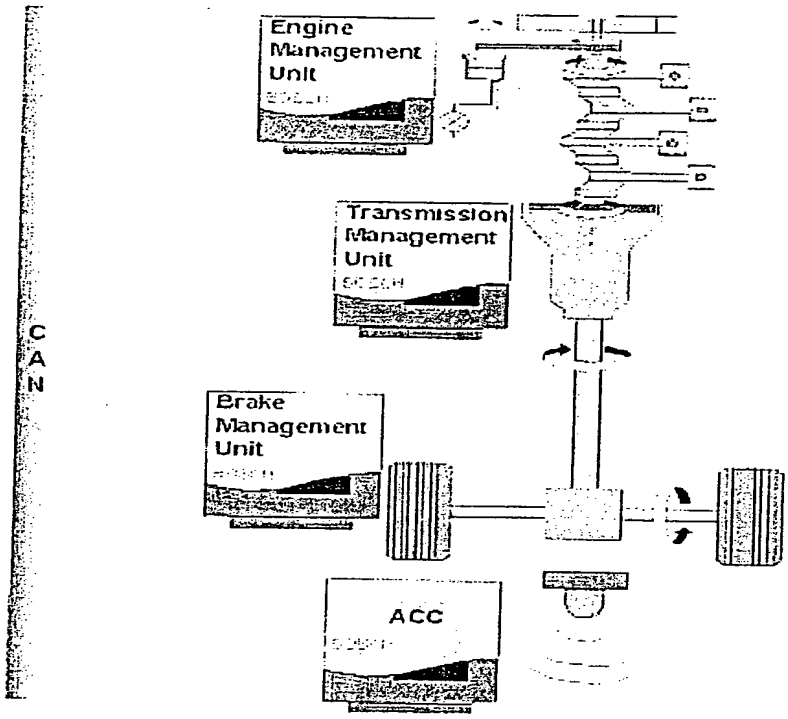

CAN
Engine Management Unit
Transmission Management Unit
Brake Management Unit
ACC

Fig. 6

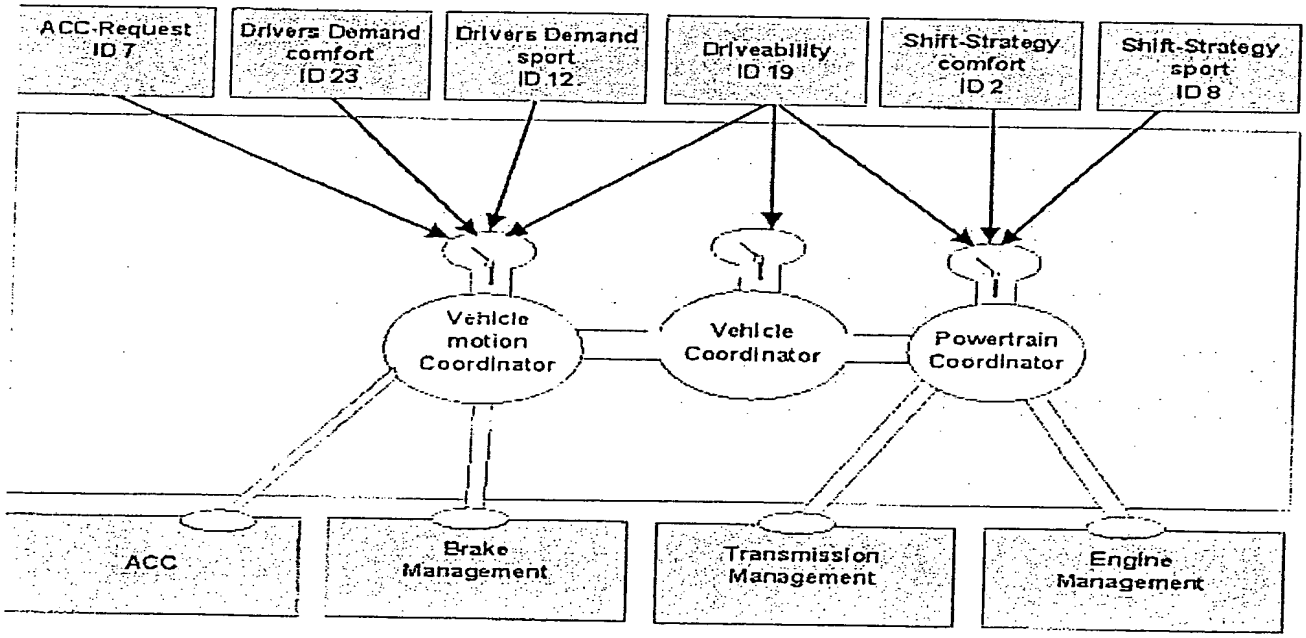

ACC-Request ID 7
Drivers Demand comfort ID 23
Drivers Demand sport ID 12
Driveability ID 19
Shift-Strategy comfort ID 2
Shift-Strategy sport ID 8
Vehicle motion Coordinator
Vehicle Coordinator
Powertrain Coordinator
ACC
Brake Management
Transmission Management
Engine Management

Fig. 7

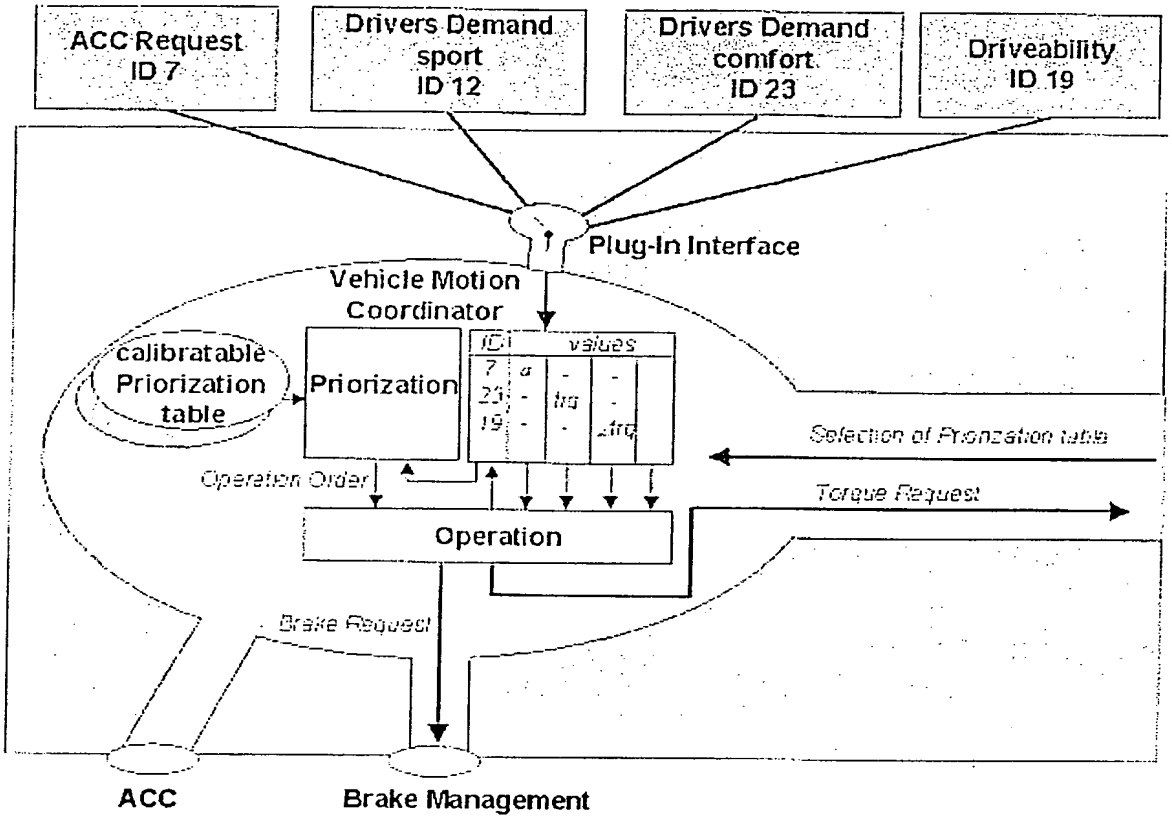

ACC Request
ID 7
Drivers Demand
sport
ID 12
Drivers Demand
comfort
ID 23
Driveability
ID 19
Plug-In Interface
Vehicle Motion
Coordinator
calibratable
Priorization
table
Priorization
ID
values
Selection of Priorization table
Operation Order
Torque Request
Operation
Brake Request
ACC
Brake Management

Fig. 8

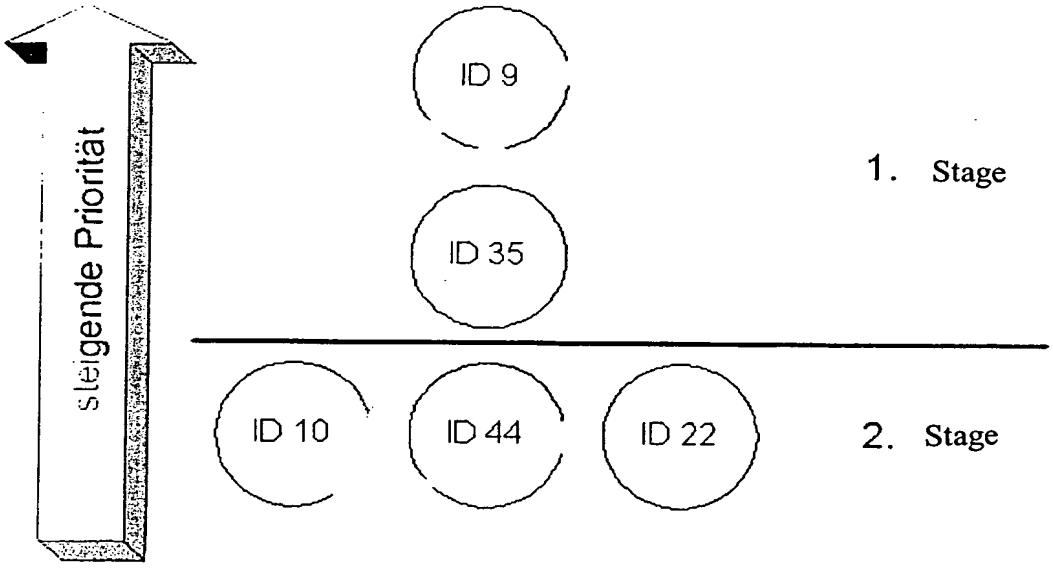

steigende Priorität
ID 9
ID 35
1. Stage
ID 10
ID 44
ID 22
2. Stage

Fig. 9

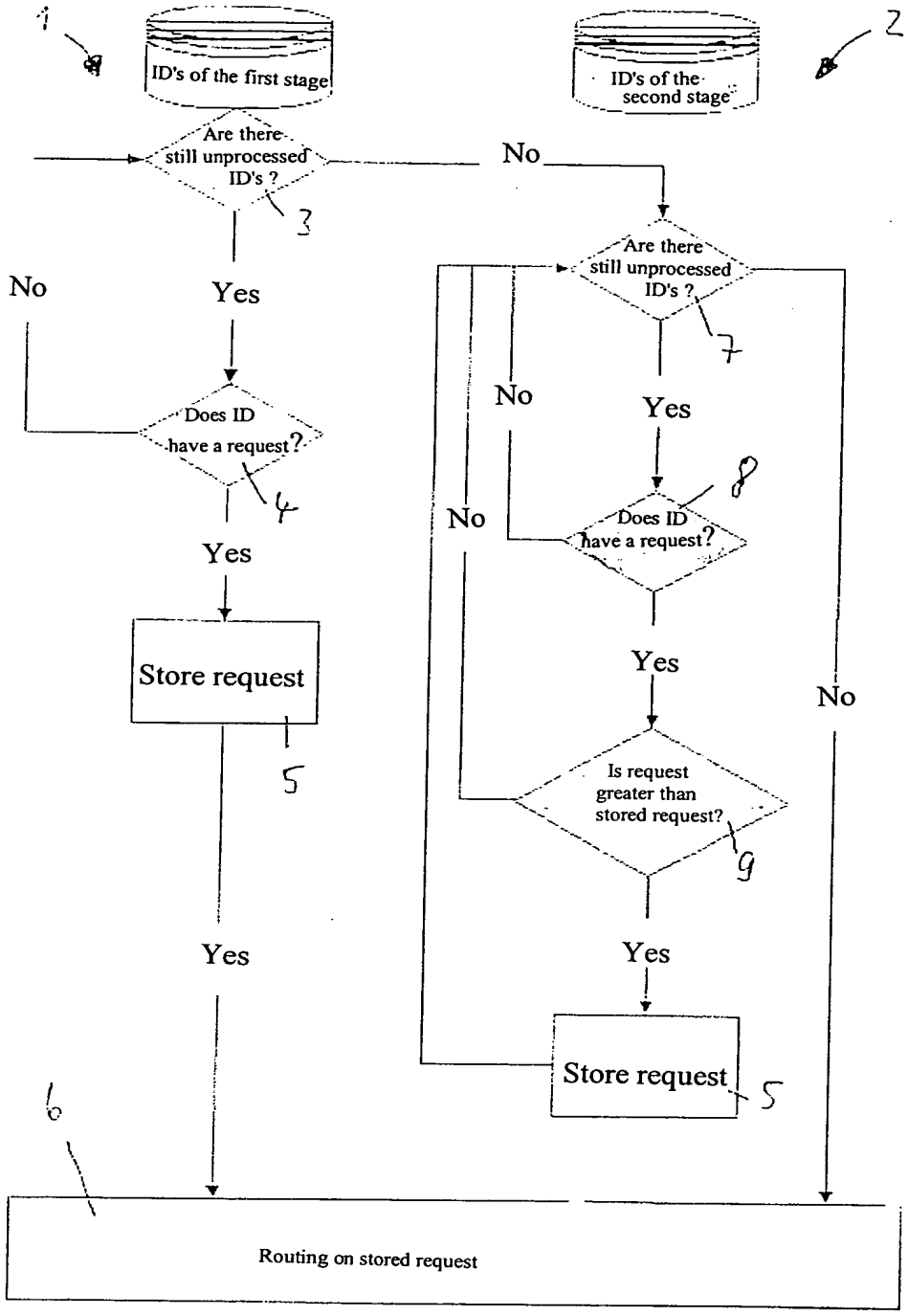

1
ID's of the first stage
2
ID's of the second stage
Are there still unprocessed ID's ?
3
No
Yes
Does ID have a request?
4
Yes
No
Store request
5
Yes
6
Routing on stored request
Are there still unprocessed ID's ?
7
No
Yes
Does ID have a request?
8
No
Yes
Is request greater than stored request?
9
Yes
No
Store request
5

Fig. 10

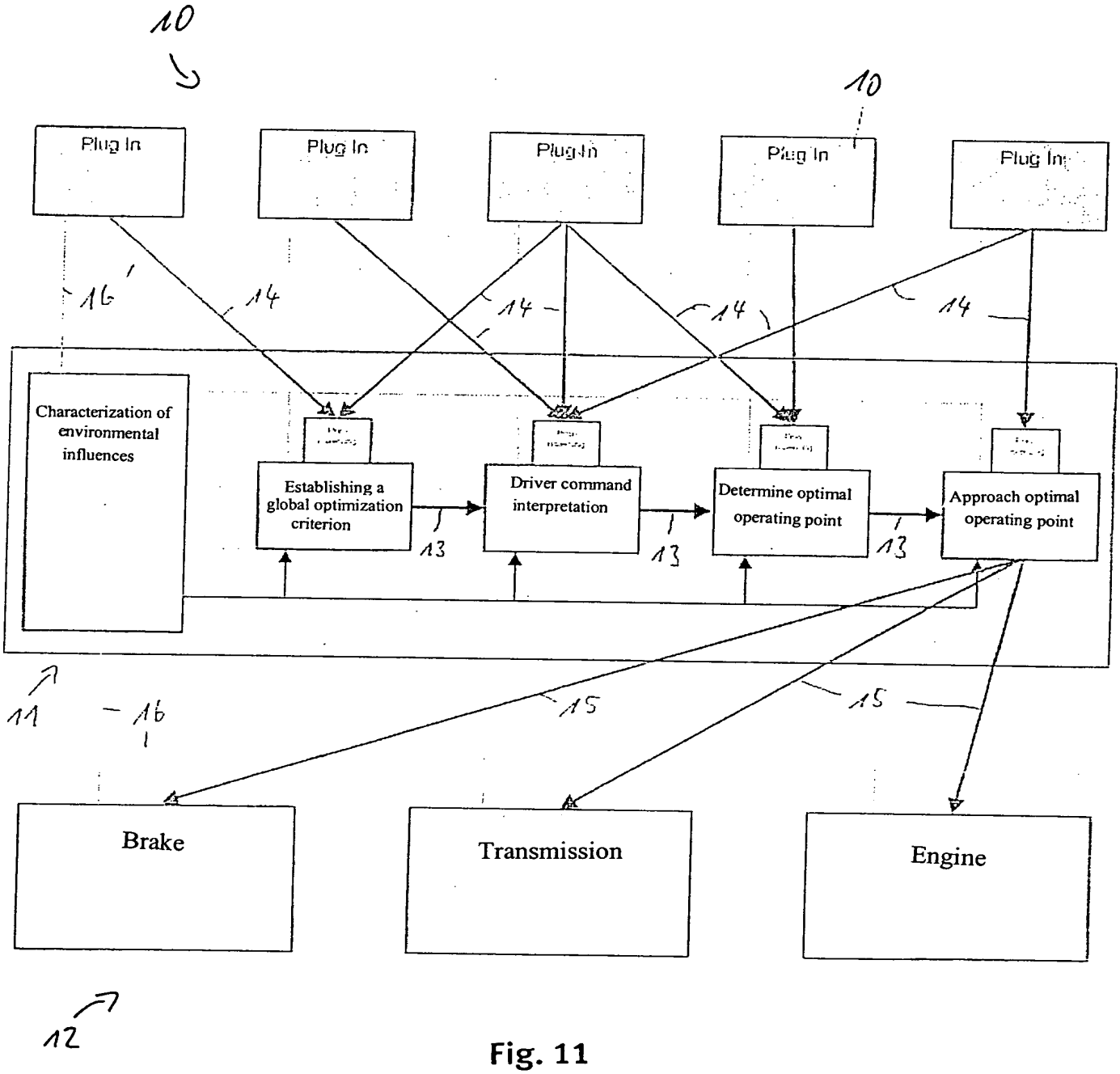

10
10
Plug In
Plug In
Plug In
Plug In
Plug In
16'
14
14
14
14
Characterization of environmental influences
Establishing a global optimization criterion
Driver command interpretation
Determine optimal operating point
Approach optimal operating point
13
13
13
11
16
15
15
Brake
Transmission
Engine
12

Fig. 11

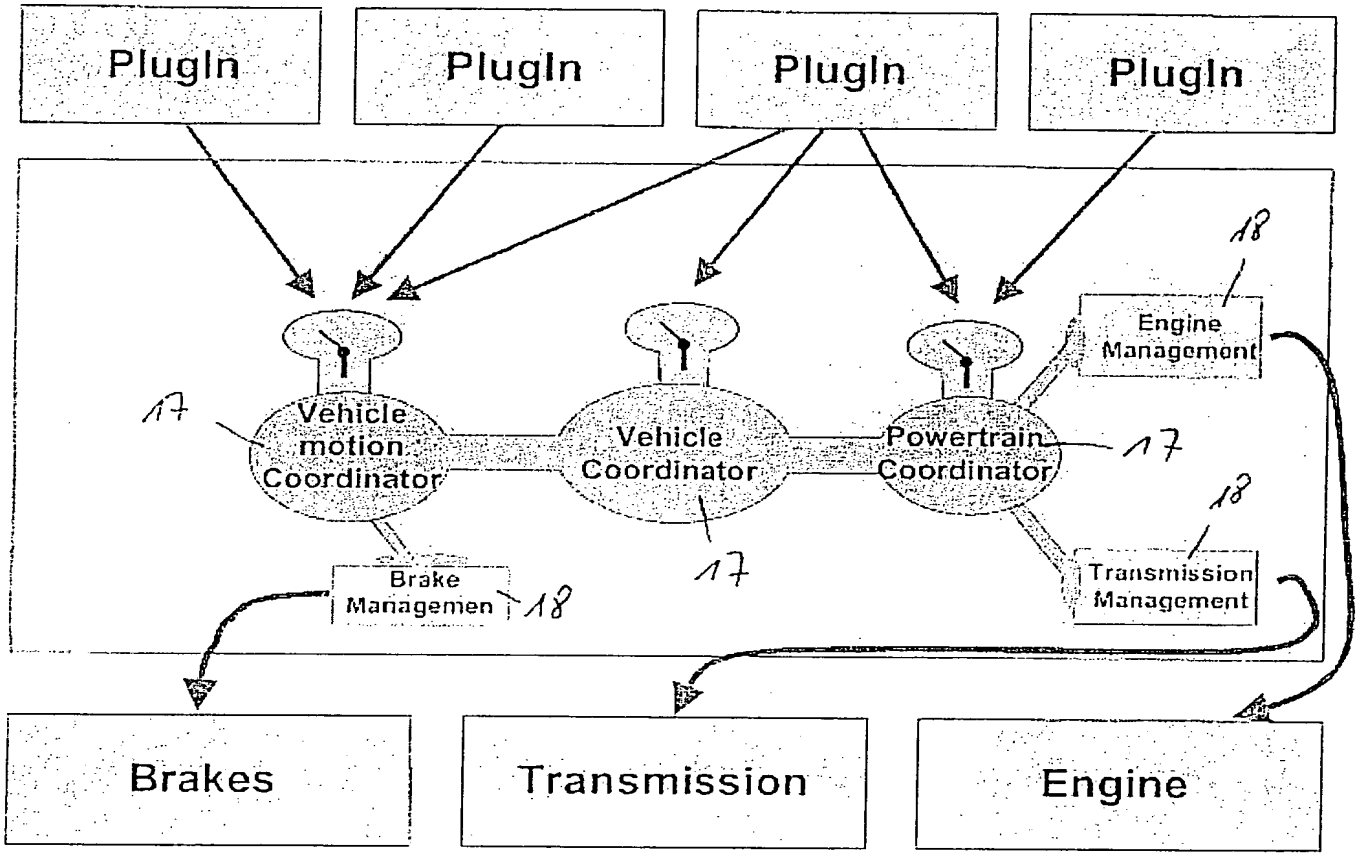

PlugIn
PlugIn
PlugIn
PlugIn
Vehicle motion Coordinator
Vehicle Coordinator
Powertrain Coordinator
Engine Management
Brake Managemen
Transmission Management
17
18
Brakes
Transmission
Engine

Fig. 12

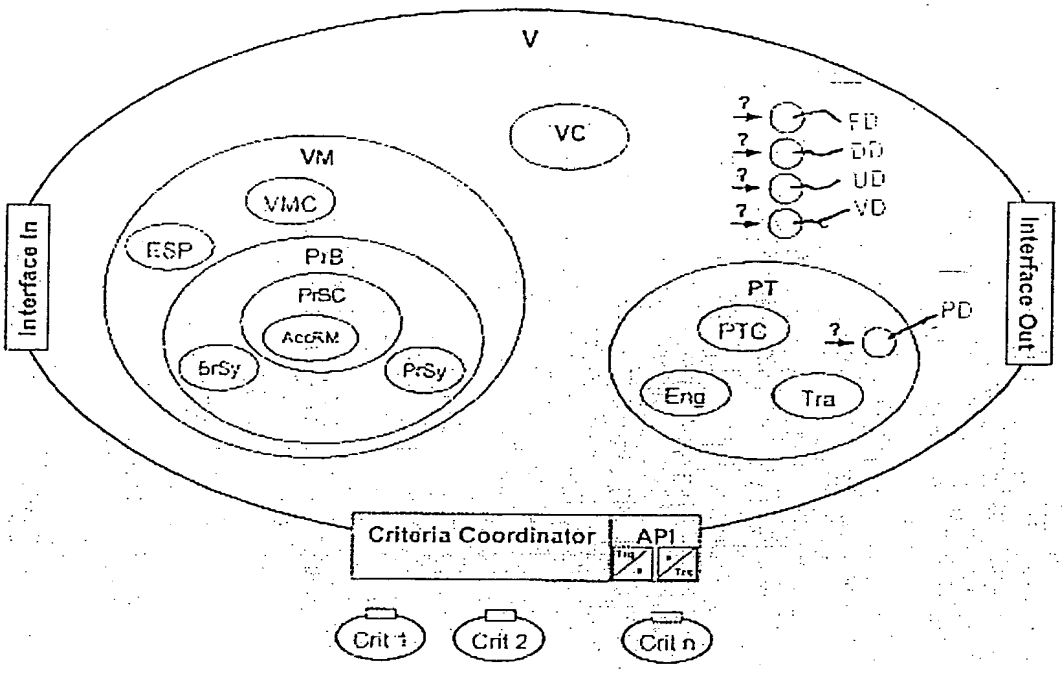

V
VC
VM
VMC
ESP
PrB
PrSC
AccRM
BrSy
PrSy
PT
PTC
Eng
Tra
FD
DD
UD
VD
PD
Interface In
Interface Out
Criteria Coordinator
API
Crit 1
Crit 2
Crit n

Fig. 13

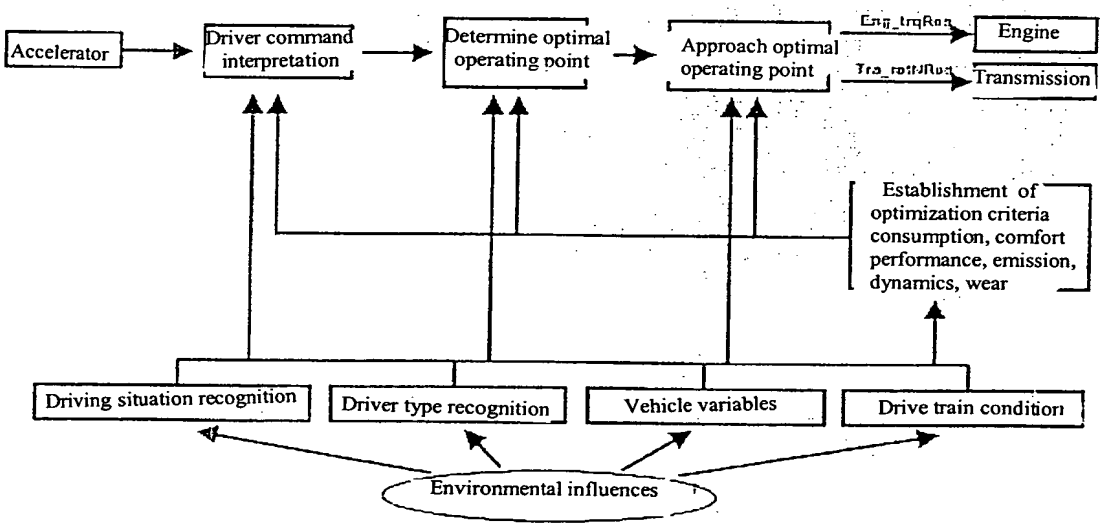

Accelerator
Driver command interpretation
Determine optimal operating point
Approach optimal operating point
Engine
Transmission
Establishment of optimization criteria consumption, comfort performance, emission, dynamics, wear
Driving situation recognition
Driver type recognition
Vehicle variables
Drive train condition
Environmental influences

Fig. 14

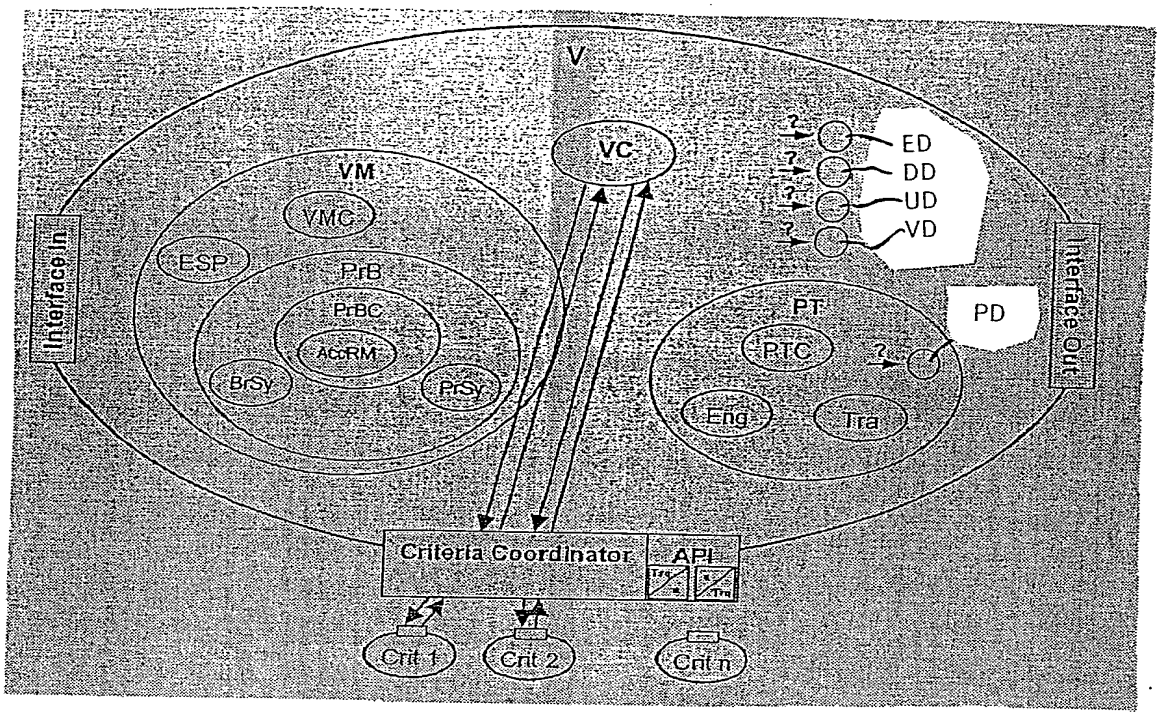

V
VC
VM
VMC
ESP
PrB
PrBC
AccRM
BrSy
PrSy
ED
DD
UD
VD
PD
PT
PTC
Eng
Tra
Interface In
Interface Out
Criteria Coordinator
API
Crit 1
Crit 2
Crit n

Fig. 15

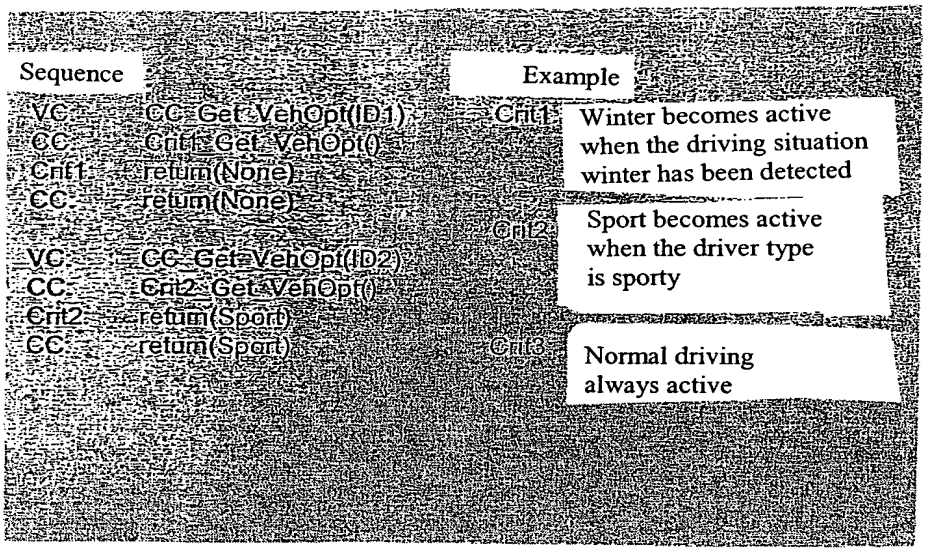

Sequence
Example
VC CC Get VehOpt(ID1)
CC Crit1 Get VehOpt()
Crit1 return(None)
CC return(None)
VC CC Get VehOpt(ID2)
CC Crit2 Get VehOpt()
Crit2 return(Sport)
CC return(Sport)
Crit1
Crit2
Crit3
Winter becomes active when the driving situation winter has been detected
Sport becomes active when the driver type is sporty
Normal driving always active

Fig. 16

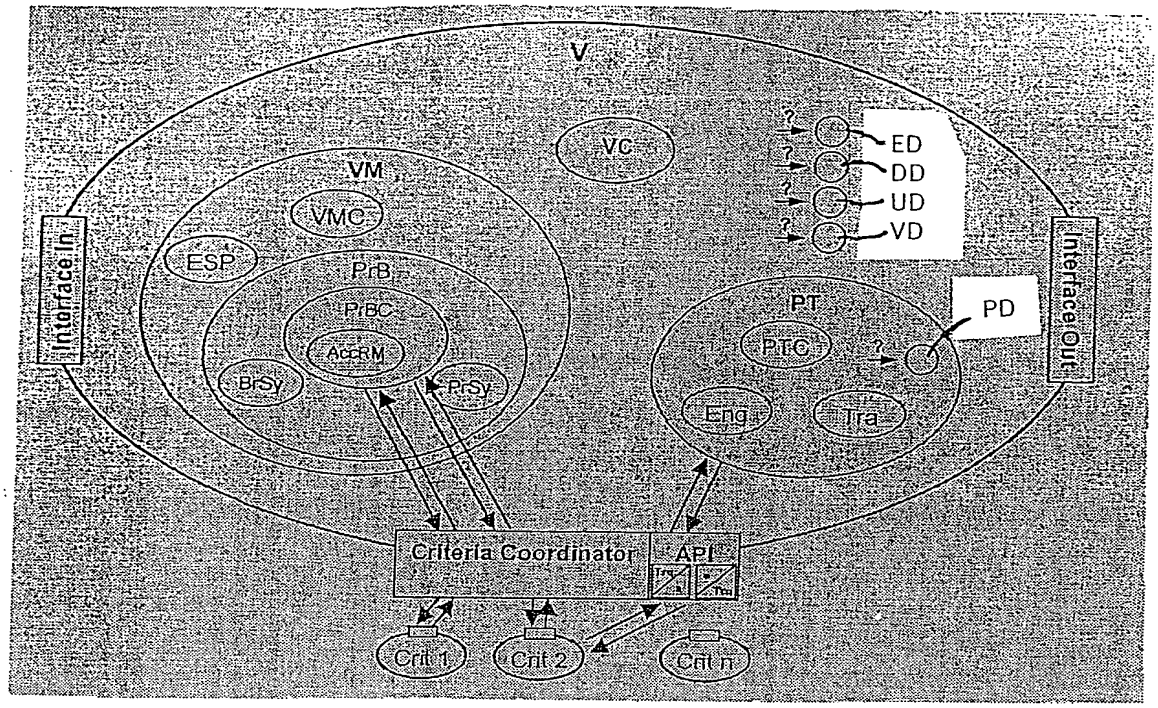

V
VC
VM
VMC
ESP
PrB
PrBC
AccRM
BrSy
PrSy
PT
PrTC
Eng
Tra
ED
DD
UD
VD
PD
Interface In
Interface Out
Criteria Coordinator
API
Crit 1
Crit 2
Crit n

Fig. 17

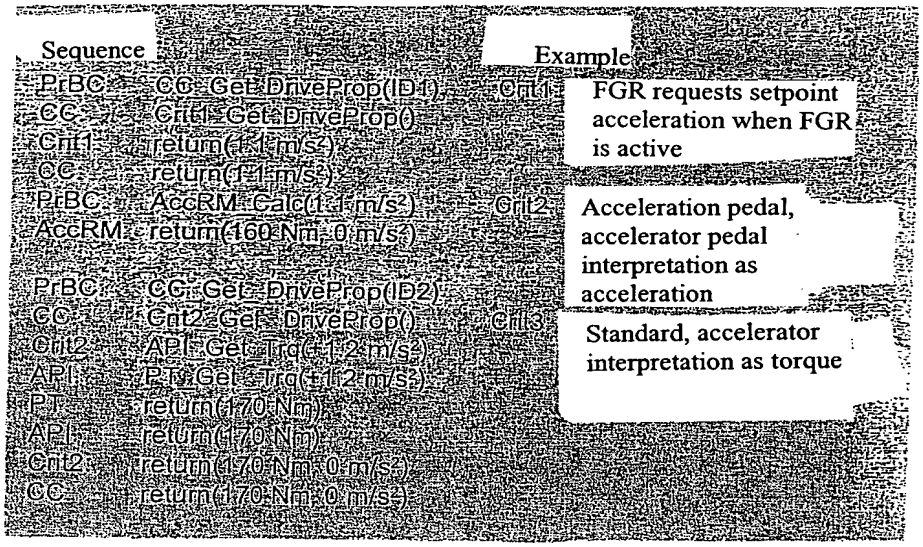

Sequence
Example
PrBC → CC: Get DrveProp(ID1)
CC → Crit1: Get DrveProp()
Crit1 → return(1.1 m/s²)
CC → return(1.1 m/s²)
PrBC → AccRM: Calc(1.1 m/s²)
AccRM → return(160 Nm, 0 m/s²)
PrBC → CC: Get DrveProp(ID2)
CC → Crit2: Get DriveProp()
Crit2 → API: Get Trq(1.2 m/s²)
API → PT: Get Trq(1.2 m/s²)
PT → return(170 Nm)
API → return(170 Nm)
Crit2 → return(170 Nm, 0 m/s²)
CC → return(170 Nm, 0 m/s²)
Crit1
FGR requests setpoint acceleration when FGR is active
Crit2
Acceleration pedal, accelerator pedal interpretation as acceleration
Crit3
Standard, accelerator interpretation as torque

Fig. 18

Interface :

Call- up: Crit_Get_DriveProp()

Return: Total acceleration a_{sum} or propulsion torque $M_{propulsion}$ and braking acceleration a_{brake} and in addition request type

0 = Inactive, no request
1 = Request is made up of $M_{propulsion}$ and a_{brake}
2 = Request is a_{sum}

Fig. 19

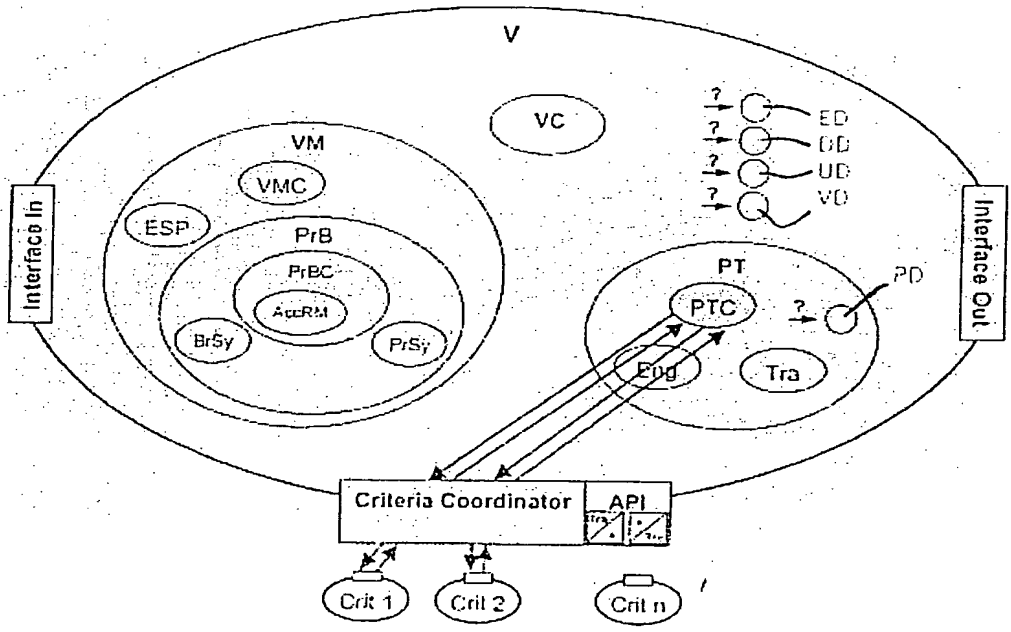


Fig. 20

Sequence :

PTC:	CC_Get_OpPointProp(ID1, 180 Nm)
CC:	Crit1_Get_OpPointProp(180 Nm)
Crit1:	return(None)
CC:	return(None)
PTC:	CC_Get_ OpPointProp(ID2, 180 Nm)
CC:	Crit2_Get_ OpPointProp(180 Nm)
Crit2:	return(120 Nm, 0.666)
CC:	return(120 Nm, 0.666)

Example :

Crit1: Sport requests an operating point having a high torques reserve

Crit2: Hill requests an operating point having higher rotary engine speed when the driving situation is active

Crit3: Eco requests a particularly fuel-saving operating point

Fig. 21

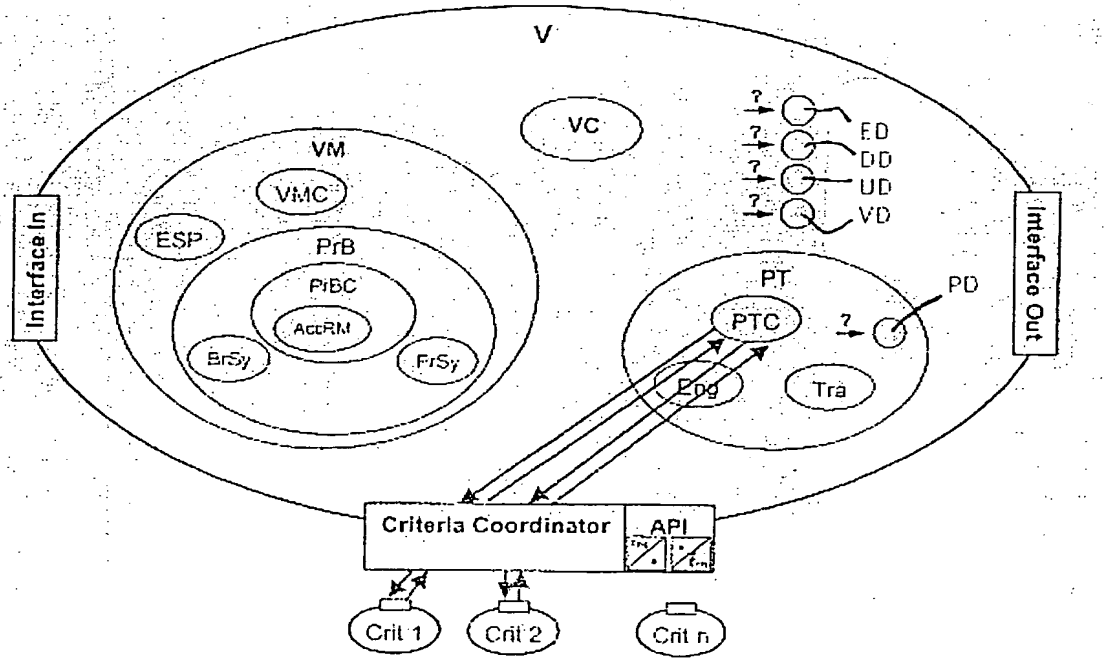


Fig. 22

Sequence :

```
PTC:    CC_Get_OpPointGrad(ID1)
CC:     Crit1_Get_OpPointGrad()
Crit1:  return(None)
CC:     return(None)

PTC:    CC_Get_ OpPointGrad(ID2)
CC:     Crit2_Get_ OpPointGrad()
Crit2:  return(None)
CC:     return(None)
```

Example :

Crit1: Curve, prevents a change in the drive train condition in borderline situations

Crit2: Winter, prevents rapid wheel torque discontinuities on a slippery roadway

Crit3: Downhill, prevents too great transmission ratios for utilization of engine-drag torque

Fig. 23

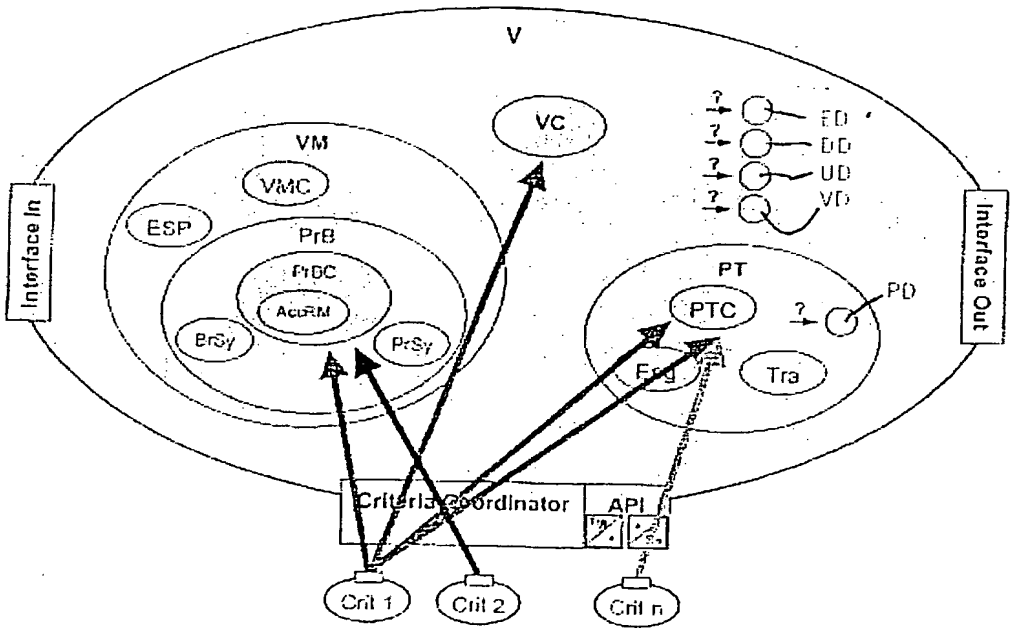


Fig. 24

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